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EXAMINER	
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ART UNIT	**PAPER NUMBER**
2828	

DATE MAILED: 08/20/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/686,208	HUSAIN ET AL.	
	Examiner	Art Unit	
	Quyen P. Leung	2828	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-27* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *1-11 and 14-24* is/are allowed.

6)☒ Claim(s) *12,13 and 25-27* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 112

1. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

2. Claims 12-13 and 25-26 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

3. Claim 12 recites the limitation "a bottom mirrors" in line 5. Did applicant mean –a bottom mirror—instead to agree with "the bottom mirror" in lines 6-7 and lines 11-12?

> 12. A multi-cavity vertical cavity surface emitting laser (VCSEL) capable of simultaneous multiple polarization emissions, comprising:
>
> a substrate;
>
> a bottom mirrors disposed on the substrate;
>
> a plurality of active regions disposed on the bottom mirror, each active region including a current aperture and a VCSEL cavity, wherein a combined active region size of the plurality of active regions is smaller than a bottom mirror size;
>
> a plurality of bottom electrodes disposed on the bottom mirror, each bottom electrode being positioned near a bottom periphery of a different one of the plurality of active regions; and
>
> a plurality of top electrodes disposed on the active region, each top electrode being positioned near a top periphery of the different one of the plurality of active region, wherein:
>
> each bottom electrode and each top electrode are positioned approximately 180 Degrees from one another around the different one of the plurality of active regions.

4. Claim 12 recites "a plurality of active regions" in line 6 and recites "the active region" in line 15. It is unclear which of the active regions in line 6 is being referred to by the active region in line 15. Claim 13 is rejected for the same reasons as claim 12.

5. Claim 25 recites the limitation "a bottom mirrors" in line 6. Did applicant mean –a bottom mirror—instead to agree with "the bottom mirror" in lines 7-8 and lines 12-13?

> 25. A method of operating a vertical cavity surface emitting laser (VCSEL) for simultaneous multiple polarization switching comprising the steps of:
>
> providing a VCSEL, the VCSEL including:
>
> a substrate;
>
> a bottom mirrors disposed on the substrate;
>
> a plurality of active regions disposed on the bottom mirror, each active region including a current aperture and a VCSEL cavity, wherein a combined active region size of the plurality of active regions is smaller than a bottom mirror size;
>
> a plurality of bottom electrodes disposed on the bottom mirror, each bottom electrode being positioned near a bottom periphery of a different one of the plurality of active regions; and
>
> a plurality of top electrodes disposed on the active region, each top electrode being positioned near a top periphery of the different one of the plurality of active region,
>
> wherein each bottom electrode and each top electrode are positioned approximately 180 Degrees from one another around the different one of the plurality of active regions; and
>
> switching one or more supply energies between a first electrically opposed pair of the plurality of top and bottom electrodes and all other electrically opposed pairs of the plurality of top and bottom electrodes.

6. Claim 25 recites "a plurality of active regions" in line 7 and recites "the active region" in lines 16-17. It is unclear which of the active regions in line 7 is being referred to by the active region in lines 16-17. Claim 26 is rejected for the same reasons as claim 25.

Claim Rejections - 35 USC § 102

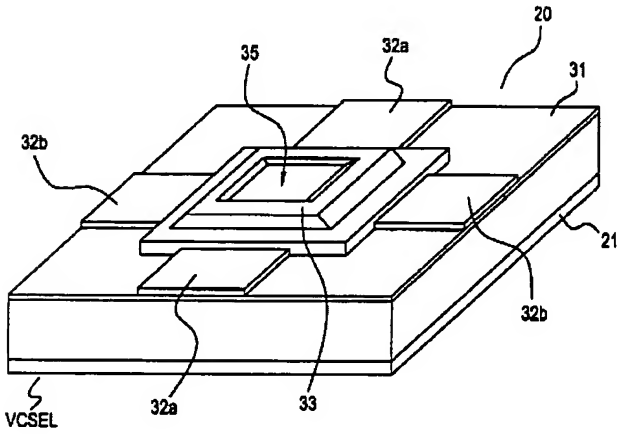
7. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

8. Claim 27 is rejected under 35 U.S.C. 102(b) as being anticipated by Kitamura et al (5,986,996). Kitamura discloses the claimed invention of a VCSEL driver circuit capable of polarization switching a VCSEL (see Figures 4-6) including a plurality of pairs (32a, 32b) of polarizing electrical contacts, the circuit comprising means (implicit in col. 15 -16) for supplying one or more supply energies to the plurality of pairs (32a,32b) of polarizing electrical contacts of the VCSEL; means (implicit) for controlling the one or more supply energies; and means (implicit) for switching the one or more supply energies between the plurality of pairs of polarizing electrical contacts of the VCSEL.

FIG. 4



for current injection. In this embodiment, the upper electrode **32** is divided by 4 into two pairs of electrodes **32***a* and **32***b*, and the pairs of electrodes **32***a* and **32***b* are formed to be in contact with the respective sides of the column **34** as shown in FIG. **6**. The interior of the upper electrode **32** serves as the aperture **35**. In the surface emitting laser VCSEL of this embodiment, a current is injected from the upper electrode **32** and is guided to the active layer **26** to be converted into light. The light is amplified by the resonator, and the laser beam is emitted from the aperture **35** to the outside. Referring to FIGS. **4**, **5**, and **6**, for descriptive convenience, the VCSEL having one column **34** is shown. However, a plurality of columns may be arranged in the surface of the substrate, as a matter of course. A plurality of optical resonators **20** each having the above arrangement can also be easily combined to each other in the form of an integrated array.

controlling and switching means implicit

In the optical pick-up of this embodiment, TE-polarized and TM-polarized laser beams can be selectively emitted from the VCSEL by switching the pairs of upper electrodes **32***a* and **32***b*. A manner of emitting laser beams having different polarization directions will be described below with reference to FIG. **6**.

FIG. **6** is a schematic view showing the VCSEL of this embodiment when viewed from a side on which a laser beam is emitted. In the VCSEL of this embodiment, the upper electrodes **32** are formed along the respective sides of the contact layer **28** having a square shape. Each opposite upper electrode **32** serves as the pairs of electrodes **32***a* and **32***b*. Here, in the VCSEL of this embodiment, when a laser is driven by using only the pair of upper electrodes **32***a*, a current from two sides of the square contacting the pair of upper electrodes **32***a* is guided to the active layer **26** while being dispersed toward the central portion of the square, thereby performing laser oscillation. When the laser is driven by using only the pair of upper electrodes **32***b*, a current from two sides perpendicular to two sides of the square contacting the upper electrodes **32***a* is similarly guided to the active layer **26** while being dispersed toward the central portion of the square, thereby performing laser oscillation.

controlling means implicit

When laser oscillation is performed as described above, the lateral cross section of the column **34** is square, and the pairs of upper electrodes **32***a* and **32***b* are symmetrically formed. Therefore, there are no differences in the characteristics of the VCSEL such as threshold current, wallplug efficiency, and the like which are performed when the VCSEL is driven by using only the pair of upper electrode **32***a* or the pair of upper electrode **32***b*.

However, the influence on the distribution of electric field near the interface at the inside and the periphery of the column **34** of the optical resonator **20** when using only the pair of upper electrodes **32***a*, is different from that when only using the pair of upper electrodes **32***b*. More specifically, when the VCSEL is not driven, due to the metal layer **30** formed around the column **34**, the distributions of electric field around the column **34** are equal to each other with respect to the respective sides of the square. The polarization direction of a laser beam which can exist inside the column **34**, is along one of orthogonal sides and cannot be controlled.

In contrast to this, when a current is injected into the VCSEL by using the pair of upper electrodes **32***a*, a distribution of electric field near the interface of the column **34** changes. Inside the column **34**, an electric field perpendicular to the sides contacting the pair of upper electrodes **32***a* easily exists. Therefore, the polarization direction of light transmitted through the inside the column **34** is equal to a direction perpendicular to the sides of the square contacting the pair of upper electrodes **32***a*. As a result, the polarization direction of an emitter laser beam has a direction in which an electric field easily exists (i.e., the direction of the pair of upper electrodes **32***a*), and the TE-polarized laser beam **7***a* is emitted.

On the other hand, the polarization direction of a laser beam emitted when a current is injected into the VCSEL by using the pair of upper electrodes **32***b*, has a direction perpendicular to the direction of the laser beam (TE-polarized light) obtained by using the pair of upper electrodes **32***a* (i.e., to be TM-polarized light), because the sides of the square contacting the pair of upper electrodes **32***b* are perpendicular to the sides contacting the pair of upper electrodes **32***a*. As a result, when a current is supplied to the VCSEL by using the pair of upper electrodes **32***b*, the TM-polarized laser beam **7***b* polarized in the direction of the pair of upper electrodes **32***b*, is emitted.

energy (current i.e.) supplying means implicit

In this manner, in the VCSEL of this embodiment, when the pair of upper electrodes **32***a* or the pair of upper electrodes **32***b* are selected to inject a current, the polarization direction of an emitted laser beam can be controlled, and TE-polarized or TM-polarized laser beams can be selectively emitted. In addition, when the lateral sectional shape of the column **34** is made square, the laser beams form orthogonal polarization directions. For this reason, laser oscillations can be stably performed.

As described above, in the optical pick-up of this embodiment, a laser beam source which can selectively irradiate laser beams having different polarization directions, is realized by using a vertical cavity surface emitting laser. The optical element **15** comprises a polarizer **9** having an aperture formed therein and arranged between the laser beam source **3** and the objective lens **5**. For this reason, by selecting only the electrode of the surface emitting laser diode to change the polarization direction of a laser beam, the effective numerical aperture NA of the objective lens **5** is controlled for optical disks having different thicknesses, and the numerical aperture of the optical element **15** can be changed. Therefore, a beam spot having high resolution can be converged on any optical disks having a different thickness. For this reason, the servo function of the optical pick-up can be utilized, and a recording/reproducing process can be reliably performed to optical disks having different thicknesses. Therefore, data processing can be reliably performed to a plurality of optical disks having different recording densities.

Furthermore, in the optical pick-up of this embodiment, laser beams having different polarization directions are selectively irradiated on optical disks having different thicknesses and different track pitches to obtain a reflected beam having high resolution. For this reason, the optical pick-up does not require a process of splitting one laser beam into a plurality of focusing points to be converged as in a conventional pick-up, and a simple optical system having high reliability can be applied to the optical pick-up. Since the optical pick-up does not require an optical element such as a prism or a hologram for splitting a laser beam, the optical pick-up having compatibility with optical disks having different thicknesses can be decreased in size and weight. In addition, since the optical pick-up of this embodiment employs, as a light source, a new vertical cavity surface emitting laser which can switch polarization directions and can be easily integrated, the optical pick-up can be further decreased in size, and have a considerably simple structure and high performance.

switching means implicit therein

Conclusion

Allowable Subject Matter

9. Claims 1-11, 14-24 are allowed.

10. Claims 12-13, 25-26 would be allowable if rewritten or amended to overcome the rejection(s) under 35 U.S.C. 112, 2nd paragraph, set forth in this Office action.

11. The following is a statement of reasons for the indication of allowable subject matter: The cited prior art do not teach or fairly suggest a VCSEL having along with the other features **a first pair of bottom electrodes disposed on the bottom mirror and near a bottom periphery of the active region**.

Conclusion

12. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Wang (5,727,014), Obrien et al (6,040,590, 6,399,407), Jonsson et al (6,356,573) and Ueki et al (6,650,583) each teaches a VCSEL having polarization control.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Quyen P. Leung whose telephone number is (571)272-1943. The examiner can normally be reached on 8-4:30, M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Minsun Harvey can be reached on (571)272-1835. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Quyen P. Leung
Primary Examiner
Art Unit 2828

QPL